# Optical Breath Gas Extravehicular Activity Sensor for the Advanced Portable Life Support System

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**The function of the infrared gas transducer used during extravehicular activity (EVA) in the current space suit is to measure and report the concentration of carbon dioxide ($CO_2$) in the ventilation loop. The next generation portable life support system (PLSS) requires highly accurate $CO_2$ sensing technology with performance beyond that presently in use on the International Space Station extravehicular mobility unit (EMU). Further, that accuracy needs to be provided over the full operating pressure range of the suit (3 to 25 psia). Accommodation within space suits demands that optical sensors meet stringent size, weight, and power requirements. A laser diode (LD) sensor based on infrared absorption spectroscopy is being developed for this purpose by Vista Photonics, Inc. Version 1.0 prototype devices were delivered to NASA Johnson Space Center (JSC) in September 2011. The prototypes were upgraded with more sophisticated communications and faster response times to version 2.0 and delivered to JSC in July 2012. The sensors incorporate a laser diode based $CO_2$ channel that also includes an incidental water vapor (humidity) measurement. The prototypes are controlled digitally with an field-programmable gate array microcontroller architecture. Based on the results of the iterative instrument development, further prototype development and testing of instruments were performed leveraging the lessons learned where feasible. The present development extends and upgrades the earlier hardware for the advanced PLSS 2.5 prototypes for testing at JSC. The prototypes provide significantly enhanced accuracy for water vapor measurement and eliminate wavelength drift affecting the earlier versions. Various improvements to the electronics and gas sampling are currently being advanced including the companion development of engineering development units that will ultimately be capable of radiation tolerance. The combination of low power electronics with the performance of a long wavelength laser spectrometer enables multi-gas sensors with significantly increased performance over that presently offered in the EMU.**

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